

(19) World Intellectual Property
Organization
International Bureau



21 JAN 2005

(43) International Publication Date
5 February 2004 (05.02.2004)

PCT

(10) International Publication Number
WO 2004/011688 A3

(51) International Patent Classification⁷: **C23C 8/00**,
16/00, H05H 1/24

N., G. [US/US]; 4922 Barnfield Drive, Keswick, VA 22947
(US). **WORTMAN, David, J.** [US/US]; 26 Talon Drive,
Niskayuna, NY 12309 (US).

(21) International Application Number:
PCT/US2003/023111

(74) Agent: **DECKER, Robert, J.**; University of Virginia
Patent Foundation, 1224 West Main Street, Suite 1-110,
Charlottesville, VA 22903 (US).

(22) International Filing Date: 24 July 2003 (24.07.2003)

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD,
SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US,
UZ, VC, VN, YU, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/398,384 25 July 2002 (25.07.2002) US

(71) Applicant (*for all designated States except US*): **UNI-
VERSITY OF VIRGINIA PATENT FOUNDATION**
[US/US]; 1224 West Main Street, Suite 1-110, Char-
lottesville, VA 22903 (US).

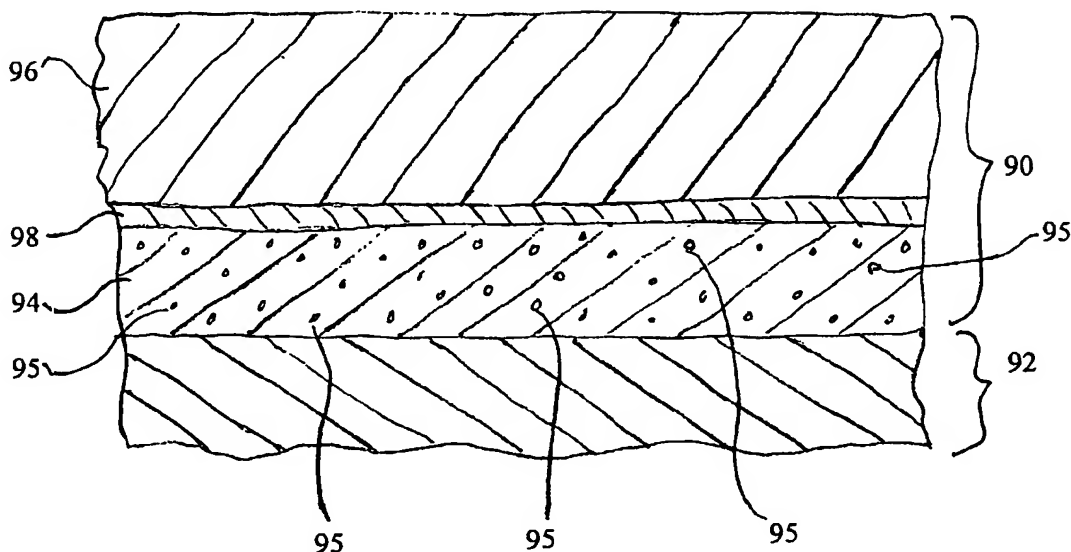
(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **WADLEY, Haydn,**

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR DISPERSION STRENGTHENED BOND COATS FOR THERMAL BARRIER COATINGS



(57) Abstract: A directed vapor deposition (DVD) method and system for applying at least one bond coating (94) on at least one substrate (92) for thermal barrier coating systems (90). The method and system provides for alloy strengthening in high temperature metallic alloys that can be melt or solid state processed to materials that one applies by vapor deposition. The creep strengthened coating (94) contains nanoscopic particles (95) of oxides, nitrides, borides, carbides, and other materials that are formed by reactive deposition. Accordingly, the resultant structure may be utilized for, but not limited thereto, high temperature coatings, e.g. for protecting rocket or power turbines, or diesel engine components. The resultant structure has a greatly extended lifetime attributed in part to the elimination of coating spallation by the "rumpling" mechanism.

WO 2004/011688 A3



Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(88) Date of publication of the international search report:

1 April 2004

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/23111

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C23C 8/00, 16/00; H05H 1/24

US CL : 427/569, 585, 250, 255.28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 427/569, 585, 250, 255.28, 582, 570, 571, 572, 573, 573, 575, 576, 561

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,210,744 B1 (HAYESS et al) 03 April 2001 (03.04.2001), column 10, line 40 - column 12, line 22.	1-30
Y	US 4,101,713 A (HIRSCH et al) 18 June 1978 (18.06.1978), entire.	1-30

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

17 November 2003 (17.11.2003)

Date of mailing of the international search report

20 JAN 2004

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Facsimile No. (703)305-3230

Authorized officer

Shrive Beck

Telephone No. (703) 308-0661